1979 Michigan Forest Pest Report

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C O N T E N T S

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INTRODUCTION

A great deal of progress was made during 1979 toward incorporating the Michigan Cooperative Forest Pest Management Program into overall forest management field operations. Pest management is an important forest management tool and this integration into everyday field activities is essential in order to gain the maximum benefit from the program.

The most important program development during 1979 was the placement of two Regional Pest Management Specialists, Ron Murray and Bob Heyd, in Region II (Northern Lower Peninsula). We felt that the best way to demonstrate the value and effectiveness of the Pest Management Program would be to concentrate our efforts in one Region. Through their day-to-day interaction with forest managers and the initiation of several important projects, Murray and Heyd accomplished a lot in getting pest management tools put into practice.

The Cooperative Crop Monitoring System (CCMS) was started during the 1979 season and was a real learning experience. We not only collected some good information on pest populations and damage, but we also learned quite a bit about what kind of a monitoring system we need.

We would like to thank everyone who was involved in the program during 1979. The cooperation received and interest shown in the program are what made 1979 a successful year and we look forward to more of the same in 1980.

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PEST CONDITIONS

INSECTS

SPRUCE BUDWORM (Choristoneura fumiferana)

Defoliation of balsam fir and white spruce was up from last year with the heaviest defoliation reported in the Western Upper Peninsula. A July aerial survey of Upper Peninsula state and private lands reported 250,890 acres of current defoliation. This includes 41,640 acres of light defoliation (e.g. noticeable reddish-brown hue; 40% defoliation); 172,520 acres of moderate defoliation (e.g. obvious reddish-brown hue; 40% defoliation without top kill or tree mortality); and 36,730 acres of heavy defoliation (e.g. striking reddish-brown hue; few to many dead tree tops; scattered tree mortality may be found). Iron County was the most extensively defoliated followed by Chippewa, Mackinac and Marquette Counties (see map). Acreages of budworm damage by defoliation class, land ownership and county are as follows:

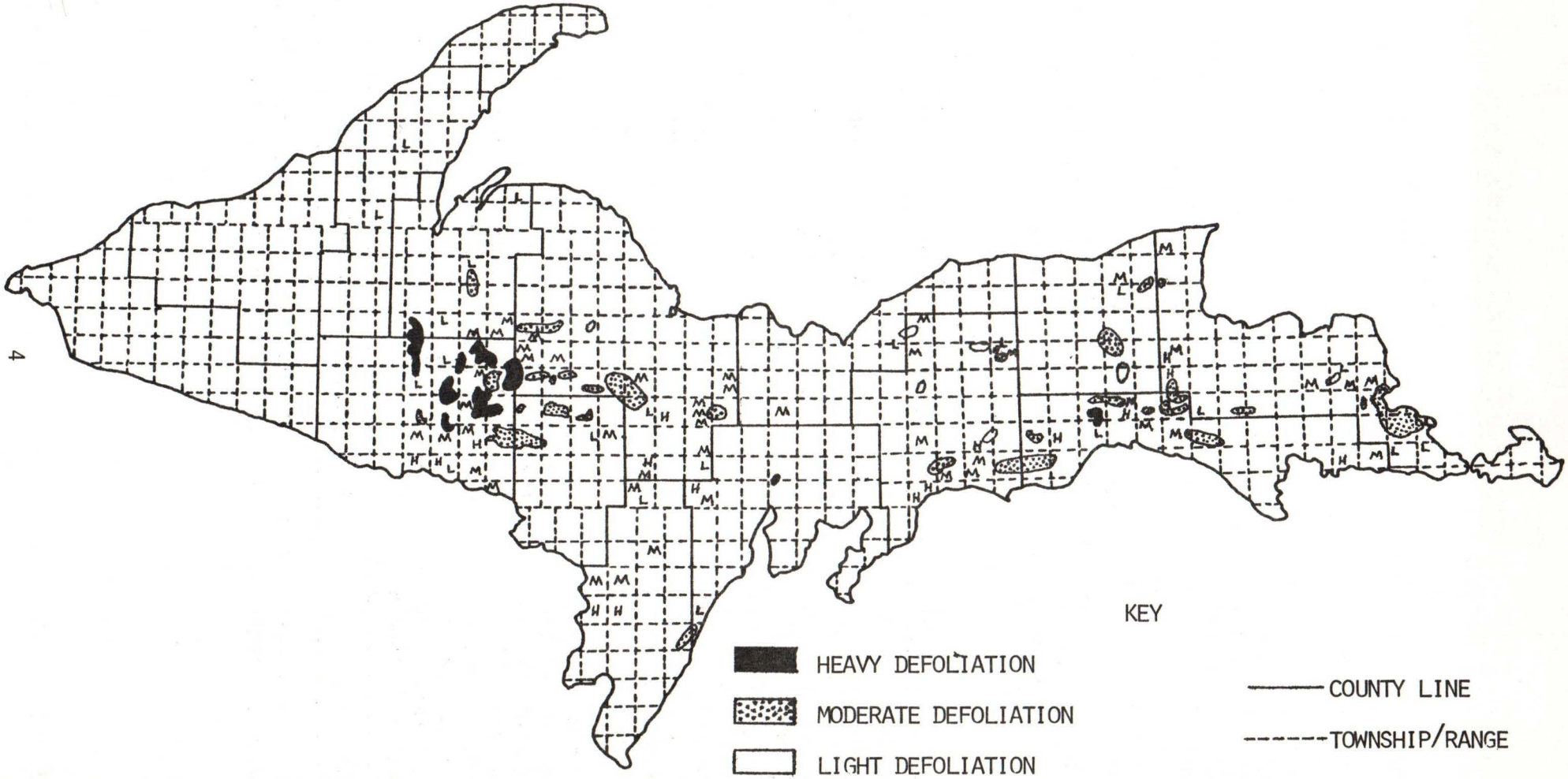
	Private Land Defoliation Class			State Land Defoliation Class		
Counties Surveyed	Light	Moderate	Heavy	Light	Moderate	Heavy
Alger (West)	-	400	-	-	-	-
Baraga	1,140	3,500	5,280	360	1,200	1,200
Chippewa (West)	320	620	300	-	1,120	400
Chippewa (Central)	960	27,520	200	2,880	12,160	640
Chippewa (East)	2,560	2,560	-	320	-	-
Delta (West)	-	160	960	1,600	160	-
Delta (East)	-	-	-	-	-	-
Dickinson	-	6,920	-	1,280	9,280	-
Houghton (North)	-	-	-	500	-	-
Iron (East)	1,000	15,220	4,550	500	7,910	10,680
Luce	620	590	-	5,760	1,780	-
Mackinac (West)	320	12,680	2,880	160	23,120	600
Mackinac (East)	1,280	-	-	640	-	-
Marquette (North)	-	-	-	-	-	-
Marquette (SW)	3,520	6,900	3,520	-	7,680	1,920
Marquette (SE)	880	12,086	160	640	9,854	500
Menominee (North)	640	1,920	640	-	-	640
Menominee (South)	-	500	-	-	2,000	-
Schoolcraft (North)	640	1,700	-	3,520	2,980	-
Schoolcraft (South)	3,400	-	500	6,200	-	520
Totals	17,280	93,276	18,990	24,360	79,244	17,740

Light to moderate defoliation of balsam fir and white spruce by the spruce budworm, was reported on 160 acres of the Pigeon River Country State Forest.

Figure 1.

SPRUCE BUDWORM CAUSED DEFOLIATION AND MORTALITY

IN SPRUCE FIR STANDS ON THE UPPER PENINSULA, MICHIGAN 1979



FOR AREAS UNDER 1 SQUARE MILE (640 AC) A CAPITAL LETTER L, M, OR H REPRESENTS LIGHT, MODERATE, AND HEAVY DEFOLIATION, RESPECTIVELY.

CCMS SUMMARY TABLE - SPRUCE BUDWORM

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Iron	3				1	2
Dickinson	2			1		
Mackinac	2				1	1
Luce	1				1	
Marquette	16	1	9	1	4	2
Menominee	5				5	
Benzie	1	1				
Schoolcraft	10	5	4	1		
Missaukee	1	1				
Cheboygan	1	1				
Otsego	5	1			4	
Baraga	1				1	
TOTAL	48	10	13	3	17	5

JACK PINE BUDWORM (Choristoneura pinus)

Jack pine budworm populations are beginning to build in the Lower Peninsula. A Cooperative Crop Monitoring System report of jack pine budworm from the Baldwin area triggered further investigation which revealed a building population in 10,350 acres of state-owned jack pine within an area encompassing slightly over 15,000 acres. Current damage was light except for 400 acres that was classified light to moderate defoliation.

The above findings coupled with knowledge of the existence of a similar infestation on U.S.F.S. land in Lake County led to an aerial survey in Alcona, Crawford, Grand Traverse, Iosco, Kalkaska, Missaukee, Ogemaw, Oscoda, Roscommon and Wexford Counties. Approximately 8,300 additional acres of light defoliation were detected on state and private lands. Further evaluation of these infestations is planned for 1980.

A moderate infestation of jack pine budworm was also detected in the Panola Plains area of Iron County in the Upper Peninsula.

CCMS SUMMARY TABLE - JACK PINE BUDWORM

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Marquette	29	29				
Baraga	1	1				
Benzie	2	2				
Clare	1	1				
Lake	3	1		1	1	
Cheboygan	5	5				
Otsego	5	5				
Gladwin	2	2				
Iron	1	1				
Roscommon	10	6	4			
Crawford	5	4	1			
Schoolcraft	16	16				
Menominee	5	5				
TOTAL	85	78	5	1	1	-

WHITE PINE WEEVIL (Pissodes strobi)

White pine weevil has caused serious damage to white and jack pine plantations throughout much of the Lower Peninsula for many years. The problem is especially severe in Kalkaska County and adjacent portions of surrounding counties. Most plantations of these species in this area have been either rendered unmerchantable or seriously damaged by this pest. A study is now being conducted to develop a model to evaluate weevil impact and analyze management alternatives to control weevil losses (See Research Section of this report). Damage appraisals conducted as part of this study in some of the stands in this region indicate losses in volume on the order of 50 percent due to weevil damage. But the greatest impact is due to excessive branches and cracked stems which make the trees difficult or impossible to harvest.

CCMS SUMMARY TABLE - WHITE PINE WEEVIL

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Baraga	2	1		1		
Roscommon	1		1			
Marquette	5		3	2		
Otsego	3			1	2	
Marquette	20	14	5	1		
Alger	5	1	2	2		
Schoolcraft	5	5				
Dickinson	2		1	1		
Benzie	1				1	
Lake	9			9		
Chippewa	1			1		
TOTAL	54	21	11	18	3	-

TWO-LINED CHESTNUT BORER (Agrilus bilineatas)

Oak mortality of perimeter trees adjacent to clearcut areas was examined. The two-lined chestnut borer appears to be the primary pest. Susceptibility to attack is attributed to tree stress associated with drought and exposure and to the fact that the two-lined chestnut borer is attracted to trees or parts of trees receiving direct sun rays. We are presently exploring the possibilities of using a recently developed method of evaluating tree stress by examining root sugars to determine the likelihood of two-lined chestnut and/or Armillaria root rot attack. This method could be used in periods of drought or after insect defoliation to determine the risk of losing residual trees in shelterwood areas, or perimeter trees in clearcut areas.

Currently the problem is most prevalent in the Lower Peninsula counties which have just suffered severe drought conditions for one or more years (especially Lake County). Borer populations are found building up in stumps of recently clearcut oak-aspen stands and then infesting adjacent stressed oak trees.

PINE ROOT COLLAR WEEVIL (Hylobius radicis)

Scotch pine, Pinus sylvestris, L., Christmas tree plantations and windbreaks continue to be severely damaged by this pest in the western portion of the northern lower Michigan. Red pine plantations adjacent to heavily infested Scotch pine are also being successfully attacked in this area. Population

levels of the weevil in some areas are high enough that pole-sized red pine are being successfully attacked in increasing numbers causing some concern to forest managers. In a cooperative effort the Canadian Forest Pest Management Research Institute, Michigan State University Cooperative Extension Service, U.S.D.A. Forest Service, and the Michigan Department of Natural Resources have agreed to address the problem by conducting toxicology tests aimed at registration of an adulticide that could be incorporated into an integrated pest management program for these insects. If the problem can be controlled for the Christmas tree grower, the impact on adjacent forest plantings should also be reduced.

FOREST TENT CATERPILLAR (Malacosoma disstria)

Numbers have declined greatly from 1978 levels in both Upper and Lower Peninsulas. There were no reports of defoliation in southern Emmet and Charlevoix Counties or in the western Upper Peninsula where moderate to heavy defoliation occurred last year. Some damage was reported to aspen in Chippewa County.

CCMS SUMMARY TABLE - FOREST TENT CATERPILLAR

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Alger	10	10				
Chippewa	12	2	1	1	8	1
Otsego	10	9	1			
Cheboygan	3	3				
Gogebic	1	1				
Marquette	20	20				
Mackinac	5	5				
Baraga	1	1				
Dickinson	2	2				
Benzie	1	1				
Menominee	5	5				
Charlevoix	1	1				
TOTAL	71	60	2	1	8	1

OAK LEAF ROLLER (Archips semiferanus)

Populations of this insect were down from last year. Scattered areas of moderate to heavy defoliation were observed in southern Crawford County and near Sanford. Several other counties also reported moderate defoliation.

CCMS SUMMARY TABLE - OAK LEAFROLLER

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Oceana	9		4	3	2	
Kalkaska	1				1	
Roscommon	9			4	5	
Lake	1				1	
Manistee	1		1			
Benzie	1		1			
Wexford	1				1	
Missaukee	1			1		
Otsego	5	5				
Clare	1				1	
Menominee	5			5		
TOTAL	35	5	6	13	11	-

DISEASES

HYPOXYLON CANKER (Hypoxylon mammatum)

Hypoxylon canker is a serious problem in the many overmature aspen stands throughout the state. Recent increased demand for aspen products will encourage cutting of this species and may help reduce the losses from this pest.

CCMS SUMMARY TABLE - HYPOXYLON CANKER

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Chippewa	6	1		1	2	2
Alger	4	2		2		
Otsego	3		2	1		
Roscommon	6	3	3			
Oceana	2		2			
Marquette	20	4		13	3	
Menominee	5			5		
Kalkaska	2			1	1	
Dickinson	1	1				
Gogebic	1		1			
TOTAL	50	11	8	23	6	2

NECTRIA CANKER (Nectria galligena)

Nectria canker was found to be sufficiently abundant in one stand of aspen and soft maple in lower Michigan to justify recommendations that extra care be taken in removing the aspen to avoid creating logging wounds. Such wounds would provide infection courts for the fungus to infect the maple being left in the residual stand. Data is not yet available but it is suspected that this situation is one that occurs from time to time in the many such stands throughout the state.

CCMS SUMMARY TABLE - HARDWOOD CANKERS (NECTRIA, EUTYPELLA)

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Benzie	1	1				
Marquette	9			2	6	
Alger	10	6	6	7	1	
TOTAL	20	7	6	9	7	-

WHITE TRUNK ROT (Fomes igniarius)

White trunk rot is prevalent in many of the state's overmature aspen stands. The increased demand for aspen products influencing harvest at a younger age should help reduce losses from this pest.

A management system developed by the U.S.D.A. Forest Service is being tried in several areas of the state as a tool to assist managers in deciding the condition and rate of decline of particular stands. This information is used to decide whether to hold a stand ten years or cut it now.

DUTCH ELM DISEASE (Ceratocystis ulmi)

American elm, Ulmus americana L., in the western half of the Upper Peninsula is rapidly succumbing to the Dutch elm disease. The principal insect vector appears to be the native elm bark beetle, Hylurgopinus rufipes.

CCMS SUMMARY TABLE - DUTCH ELM DISEASE

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Gogebic	1			1		
Marquette	6	1				5
Chippewa	1					
Alger	10	9	1			
Dickinson	1					1
Kalkaska	1					1
Menominee	5				5	
TOTAL	25	10	1	1	5	7

OAK WILT (Ceratocystis fagacearam)

An epicenter of oak wilt approximately one-half acre in size was discovered by operations inventory personnel near the parking lot for the Muncie Lakes Ski Trail in the Traverse City Area of the Pere Marquette State Forest. It was reported to the Michigan Department of Agriculture. The area will be cut for firewood this winter. All oak, regardless of size will be felled within the infected area and surrounding treatment zone. Stumps will be treated according to MDA specifications when sprouting begins next spring. Chemical used in stump treatment will be supplied by MDA.

CCMS SUMMARY TABLE - OAK WILT

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Clare	2	2				
Otsego	5	5				
Cheboygan	5	5				
Missaukee	1	1				
Wexford	1	1				
Benzie	1	1				
TOTAL	15	15	-	-	-	-

SCLERODERRIS CANKER (Gremmeniella abietina)

Damage was down from last years high levels. But the disease is still a major concern in the Danaher Plains area in Schoolcraft County.

CCMS SUMMARY TABLE - SCLERODERRIS CANKER

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Iron	1	1				
Marquette	20	15	5			
Schoolcraft	10			1		9
Dickinson	2	2				
Baraga	2	1	1			
Chippewa	5	5				
Menominee	4	4				
Alger	1					1
TOTAL	45	28	6	1	-	10

MINOR PEST PROBLEMS

PEST	HOST(S)	LOCATION	REMARKS
Bark Beetles (*Ips sp.*)	*Pinus resinosa* *P. banksiana*	Northern Michigan (Widespread)	Primarily pockets of 1/4 acre or less; correlated with very high drought index this year
Birch Leaf Miner *Fenusa pusilla*	*Betula papyrifera*	Northern Lower Michigan Upper Peninsula	Up to 90% defoliation on several hundred acres
European Pine Sawfly *Neodiprion sertifer*	*Pinus sylvestris* (*Pinus banksiana*)	Lower Peninsula (Widespread)	Primarily a problem of Christmas tree plantations; heavy defoliation
Introduced Pine Sawfly *Diprion similis*	*Pinus strobus* *Pinus sylvestris*	Northern Lower Michigan (Especially abundant in Antrim & Otsego Counties)	Little defoliation; primarily homeowner nuisance
Pine Spittlebug *Aphrophora parallela*	*Pinus sylvestris* *Pinus strobus*	Lower Peninsula	Widespread problem; mortality of 20 ft. white and Scotts pines in a few areas
Red-headed Pine Sawfly *Neodiprion lecontei*	*Pinus banksiana* *Pinus resinosa*	Wexford County	Two isolated colonies discovered
Red Pine Needle Midge *Thecodiplosis piniresonosae*	*Pinus resinosa* (Pole size trees)	Northern Lower Michigan (Crawford, Kalkaska, Missaukee, Oscoda, Roscommon Counties)	Recently detected - 80-100% of shoot tips flagged in heavy areas
Zimmerman Pine Moth *Dioryctria zimmermani*	*Pinus resinosa*	Northern Lower Michigan	Damaging shoots of pole size to mature red pine

CCMS SUMMARY TABLES FOR OTHER INSECT AND DISEASE PESTS

PINE ENGRAVER

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Otsego	5	5				
Schoolcraft	5	3	1	1		
Alger	5	2	3			
Roscommon	14	12	2			
Marquette	20	15	5			
TOTAL	49	37	11	1	-	-

SARATOGA SPITTLEBUG

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Oceana	5	5				
Marquette	18	16	2			
Cheboygan	6	5			1	
Manistee	1	1				
Dickinson	4	4				
Lake	16	12		1	1	2
Menominee	6	4	2			
Chippewa	11	9				2
Schoolcraft	5	5				
Baraga	1	1				
Alger	5	5				
Kalkaska	1				1	
Mackinac	1		1			
TOTAL	80	67	5	1	3	4

JACK PINE SAWFLY

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Marquette	19	19				
Baraga	1	1				
Benzie	2	2				
Cheboygan	5	5				
Otsego	5	4	1			
Roscommon	5	3	2			
Schoolcraft	16	16				
Kalkaska	1		1			
Menominee	5		5			
TOTAL	59	50	9	-	-	-

RED HEADED PINE SAWFLY

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Marquette	20	19		1		
Cheboygan	3	3				
Kalkaska	1	1				
Wexford	1	1				
Roscommon	14	14				
Dickinson	1	1				
Alger	5	5				
Schoolcraft	5	5				
Baraga	6	1	5			
TOTAL	56	50	5	1	-	-

SADDLED PROMINENT

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Dickinson	1	1				
Benzie	1	1				
Cheboygan	3	3				
Otsego	3	3				
Missaukee	1	1				
Kalkaska	1	1				
Baraga	1	1				
Schoolcraft	5	5				
Alger	5	5				
Clare	1	1				
Marquette	10	10				
TOTAL	32	32	-	-	-	-

WHITE PINE BLISTER RUST

COUNTY	NUMBER REPORTS	DAMAGE SEVERITY NONE	TRACE	LIGHT	MODERATE	HEAVY
Marquette	20	7	4	9		
Menominee	1	1				
Dickinson	4		3	1		
Cheboygan	7	6	1			
Otsego	8	4	4			
Houghton	1		1			
Chippewa	8	3	4	1		
Mackinac	2		1		1	
Oceana	4	4				
Benzie	1	1				
Lake	10	9		1		
Baraga	1	1	1			
Iron	2	1	1			
Schoolcraft	4	1		2	1	
Alger	12	3	7	2		
TOTAL	85	41	27	16	2	-

SURVEY AND MONITORING

AERIAL SURVEY FOR DEFOLIATORS

A 2.7 million acre aerial survey of state, federal and private land in Region II was made on June 26-28. Approximately 45,000 acres of northern hardwoods displayed various degrees of defoliation of aspen, birch and oak. Defoliation ranged to 60 percent with a few local areas of 60 to 90 percent defoliation. Aspen defoliation was the most widespread problem with 50 percent defoliation being a common occurrence on low, wet sites. Ground checks revealed a complex of aspen leaf-rollers was responsible.

Many phone and written communications were received regarding the oak leaf roller. The oak leaf roller was more of a nuisance problem and not generally responsible for heavy defoliation. People complained of larvae falling on picnic tables, chairs and themselves.

Scattered areas of oak forest in an area comprising six sections in southern Crawford County experienced from 50 to 90% defoliation from the oak leaf complex. Moderate to heavy defoliation caused by an oak leaf roller-canker-worm complex was found near Sanford.

A few local areas of current spruce budworm activity were spotted in Charlevoix, Emmet, Presque Isle and Roscommon Counties. The forest tent caterpillar was not noticeable in Emmet County or other areas this year. Lastly, several areas of birch mortality caused by water table fluctuations were noted throughout the Region.

SARATOGA SPITTLEBUG (Aphrophora saratogensis)

Region II red and jack pine planting sites and plantations less than ten years old were risk-rated for Saratoga spittlebug damage. A total of 7,282 acres were risk-rated. Of this, we found 945 acres of high risk sites, and 1,494 acres of moderate risk sites requiring further consideration. High risk means a potential loss of the total merchantable volume, and moderate risk represents a ten years' lost growth (e.g. volume at year 30 of damaged planting = volume at year 20 of undamaged planting).

Spittlebug surveys on the high risk acreage found no threatening populations in 1979. Moderate risk areas were not visited because no problems existed on high risk sites where populations would first become evident. These moderate and high risk sites will be monitored periodically until beyond the spittlebug susceptible height range (i.e. 3-15 feet).

The Region I helicopter was used to risk-rate 90 plantations representing 5,830 acres. These sites were scattered throughout Region II south of M-72. Fifteen hours of flight time in three days were required. The helicopter proved to be an effective tool, saving many hours of ground work and vehicle miles while affording a more complete and accurate view of the plantation ground cover than is possible from the ground. In addition, locating plantations in difficult areas due to terrain, confusing road systems, inaccurate descriptions, etc. is greatly expedited.

DAMAGE APPRAISALS

Much time was spent developing damage appraisal mehtods for use in red and jack pine plantations damaged by Saratoga spittlebug and in jack pine plantations damaged by white pine weevil. Various methods were tried and evaluated on spittlebug damaged plantations until a final method was selected that provided a good combination of information in a minimal amount of time. This method is designed to enable us to provide managers with an appraisal of pest impact (mortality and growth loss) on the plantation to date so that the real potential of the stand to produce future values can be assessed and future management decisions can be made in the light of past losses and present values. Plans are to examine the red and jack pine plantations in the 1981 and subsequent compartments as they come up for examination on operations inventory. Ultimately it is planned that such a system will be used to provide (1) data on pest damage conditions regionwide and (2) data for stand management decisions regarding individual pest situations.

Details of these systems are explained under the Research Section of this report. Thus far the plantations that have been appraised show losses ranging from 35 to 65 percent growth loss in thirty years due to white pine weevil in individual jack pine plantations. Losses in individual red pine plantations caused by Saratoga spittlebug have been from 35 to 48 percent growth loss on surviving trees plus 20 percent mortality, some of which can be attributed to spittlebug in addition to various other possible causes.

FOREST TENT CATERPILLAR EGG MASS SURVEY

A sequential survey for forest tent caterpiller (Malacosoma disstria Hubner) egg masses was used to predict the degree of defoliation in Emmet and Charlevoix Counties for 1979. Based on the results of the survey, the Petoskey News and a concerned citizens' group were informed that the defoliation in 1979 would be considerably less than in the previous year.

RESPONSES OF OBSERVERS TO THE COOPERATIVE CROP MONITORING SYSTEM

At the end of the 1979 field season a questionnaire was sent out to 159 people who participated in the CCMS for forest pests. Forty-six of the 159 on the mailing list sent in survey reports during the field season. Sixty-four (40%) of the questionnaires were returned. Of the 64, there were 30 DNR foresters, 25 DNR fire officers and 9 "others." "Others" were DNR Forest Technicians, a county forester, YACC rangers, a private forestry consultant, and a DNR equipment operator.

I. Observer's time commitment and interest in CCMS

Half the individuals who responded to the questionnaire estimated that they spent less than one hour per week on the CCMS forest pest survey. They may not have surveyed at all though, since about the same number gave reasons for not participating. The actual time spent by most participating observers was probably 2-3 hours per week. Most of the people who did not conduct the survey were unable to because of higher priority work duties, because it was done by someone else at their office, or because supervisors did not permit them to.

Foresters and fire officers both mentioned they thought a forester could do the job more efficiently and accurately and suggested that forest technicians might be involved in surveying as well.

The field forms were completed in 5-15 minutes by most observers and office planning time for each host type ranged from zero to an hour. Travel time added to that significantly.

Nearly all of the people responding felt that some type of forest pest monitoring was worthwhile and most rated their interest in CCMS as moderate.

II. Feedback via MSU's insect, disease and nematode alerts

The "Alerts" appear to be popular. Several people wrote that they appreciated knowing what was going on across the state and what to look for in the future. It also helped them to answer questions from the public and to recommend proper control techniques. Those from the Upper Peninsula found the information less useful though because the timing of insect development was 3-4 weeks behind that reported in the Alerts for the Lower Peninsula. Illustrations of pests and more maps would be helpful to readers.

III. Monitoring system improvements and modifications

Most of the individuals who commented felt that the value of the survey was not enough to warrant such time-consuming procedures. They suggested: a) filling out one report for the average situation instead of for five different locations, b) not filling out a report when no damage was found, c) eliminating the minor host type component of the survey, and d) eliminating some of the diseases and insects from the list on which no control action will be taken. A few mentioned they would prefer permanent survey routes to the present system. One individual suggested strengthening survey information with detailed information on disease infection rates from timber sales.

The response to the computer-scannable form was very favorable. Several suggestions on modifications to the contents were made.

Foresters and fire officers agreed that more information on insect and disease identification is needed and said they would like to see more color slides of pests in winter training sessions. They also felt that control measures should get more emphasis. Several individuals suggested field trips during the spring or summer.

RESEARCH PROGRESS

SPRUCE BUDWORM (Choristoneura fumiferana)

Several related projects on spruce budworm stand impact are being conducted by the School of Natural Resources at the University of Michigan. This was the second year of the Michigan Impact Study System which includes 136 ground sampling units located in spruce-fir stands in the Upper Peninsula. These units will be measured again next year. The number and size of ground sampling units required to accurately estimate tree mortality in stands infested with spruce budworm was determined. The accuracy of tree mortality estimates attained through remote sensing techniques was also investigated. Information on field techniques for assessing the impact of spruce budworm was published in volume 12 of the Great Lakes Entomologist pages 213-218.

A five year project to improve sampling techniques of low and moderate population levels commenced in June 1979. The research is a cooperative effort between Michigan State University's Department of Entomology and the University of Michigan's School of Natural Resources. The first year's work was designed to look at egg mass numbers on balsam fir foliage in Michigan's Upper Peninsula. Data will be used to establish a model for egg mass distribution within a tree and a stand. This model would establish the optimum egg mass sampling procedure for accurately estimating the following years population for a particular forest unit. Subsequent investigations are designed to reveal the most efficient techniques to use in examining the other life stages, culminating in an accurate, workable monitoring system.

Twenty-five years of historical light trap data from the state of Maine has been analyzed at Michigan State University's Department of Entomology. Numbers of spruce budworm moths caught over an entire flight period were related to the onset of defoliation. It was found that if trap catch was between 12 to 30 moths, defoliation became apparent between 3 and 5 years later. During the time that defoliation was occurring, trap catches were as high as 2,000 15,000 moths. In contrast, at endemic (or low) population levels trap catches were generally less than 10 moths, usually zero. Thus, light trap data can give land managers three to five years lead time in planning harvesting or spray operations in spruce-fir stands.

In a cooperative project between the University of Georgia's and Michigan State University's Departments of Entomology, work has begun on relating spray droplet size to the microenvironment of the spruce budworm. Last year a quick method for analyzing droplet deposits on foliage was developed. This year various spectra of droplet sizes will be applied similar to the way it is done in a large scale aerial spray application. Meteorological influences and the distribution of droplets and droplet sizes within a tree will be monitored. It may be possible to eventually direct the spray more to the budworm and less to its predators and parasites.

Greentree Consultants of Lansing are currently working on the development of a guidebook of resource value estimators to be used by national forest personnel in forest insect and disease management planning. This will be based on an economic model of the detrimental and beneficial effects of the spruce budworm. The guidelines are scheduled for field testing in 1980.

BLACK WALUNT DEFECT AND DECAY

Defects from walnut trees in Michigan and Wisconsin were collected and examined in research done at Michigan State University's Department of Botany and Plant Pathology. Causes of the defects were: branch stubs, ice damage, cattle damage, nectria cankers, frost cracks, test borings, and lightening strikes. Branch stubs were the most common cause of defect. Fungal and bacterial isolations on these defects were done and numerous organisms identified. In addition, blocks of both sapwood and heartwood of walnut were exposed to two of the common decay microorganisms to examine the effect of ring width on decay rates. Ring width, i.e. growth rate, does not appear to alter decay rate.

MYCORRHIZAE

At the Forestry Department at Michigan Technological University, preliminary work has been initiated to improve levels of out-planting success by inoculation of nursery stock with mycorrhizal fungi.

DUTCH ELM DISEASE (Ceratocystis ulmi)

A project conducted by Michigan Technological University and the State and Private Forestry Division of the U.S.F.S. has found Dursban (Dow) to give excellent control of the native elm bark beetle (Hylurgopinus rufipes) in a fall application to the lower 10 feet of the tree bole. A Forest Service bulletin will be published on this research soon.

BRONZE BIRCH BORER (Agrilus anxius)

In the spring of 1979 a study on the relationship between bronze birch borer emergence and tree vigor was conducted. European white birch trees (Betula pendula) ranged from completely healthy to those that had recently died. Only those trees which had died during winter or late summer the previous year showed evidence of borer emergence along the lower bole during early summer. Trees that were healthy or had some crown dieback did not allow beetles to emerge. Therefore, trees which have the greatest potential of producing a large adult borer population are trees that are near death or have just died. These trees should be removed in early spring to minimize the number of adult borers released into an area.

HYPOXYLON CANKER (Hypoxylon mammatum)

In research conducted by the University of Michigan's School of Natural Resources, different fungi were found in putative resistant and susceptible clones of aspen, which may explain part of the variation resistance. Also, a beetle in the Lathridiidae family has been found in the blisters containing the sexual stage of the fungus. Although this insect has not been established as a vector, the clumped distribution of infected trees indicates that an insect vector may be involved in the dissemination of hypoxylon canker.

DUTCH ELM DISEASE (Ceratocystis ulmi)

At the School of Natural Resources at the University of Michigan, research has begun on the occurrence of the sexual stage of C. ulmi in nature. The morphological sexual stage has been identified and mating and pathogenicity tests are now being conducted.

NEEDLECAST DISEASES OF DOUGLAS FIR

Two years of research on Swiss needlecast (Phaeocryptopus graumanni) have recently been completed at the School of Natural Resources at the University of Michigan. The phenology, disease implications, and potential chemical controls were studied. Work was also done on Rhabdocline weirri to determine its distribution in Michigan and possible chemical control. Taxonomic work will be continued. Results of this research of Douglas fir needlecast diseases will be presented at the upcoming Michigan Academy of Science meeting.

GYPSY MOTH (Lymantria dispar)

At Michigan State University, studies are being done to develop a catalog or listing of the larval and pupal parasites of gypsy moth in Michigan. Additional studies are planned on the basic biology of this hardwood defoliator.

Ron Priest of the Michigan Department of Agriculture released a hymenopterous egg parasite (Oencyrtus guwanei) in two locations in the state where gypsy moth was present. These locations will be rechecked to determine whether or not the parasite is successfully established.

PALES WEEVIL (Hylobius pales)

Behavioral and non-chemical control studies have continued on this Christmas tree pest. Tests indicate that when Scots and white pine are cut in such a way that a whorl of living branches is left intact, weevil attack is reduced. The larvae normally develop in the stump or roots of dead trees. This research is being conducted by the North Central Forest Experiment Station of the U.S.F.S. in cooperation with Michigan State University.

COTTONWOOD LEAF BEETLE (Chrysomela scripta)

This insect has been identified as a pest of intensive culture Populus spp. in the Lake States. Research conducted by the North Central Forest Experiment Station of the U.S.F.S. has shown that the cottonwood leaf beetle can be controlled by monitored overhead irrigation. Heavy doses of water or sewage effluent applied after first generation larval eclosion knocks the larvae off the trees and drives adults to drier locations.

DAMAGE APPRAISAL METHOD FOR RED & JACK PINE PLANTATIONS ATTACKED BY SARATOGA SPITTLEBUG

Red and jack pine plantations were risk-rated for Saratoga spittlebug during June. At that time it was noticed that many high risk and some moderate risk plantations had suffered noticeable damage from past populations. In order to quantify their losses, the system described was used.

Samples were taken from plantations known to have suffered varying degrees of damage from Saratoga spittlebug. Data was analyzed and the minimum number of plots required to measure the variation present was calculated. On a 10' x 7' spaced plantation this became every tenth tree in every ninth row (31 trees/acre).

After carefully examining evidence to assure that the cause of the damage is Saratoga spittlebug (or another specific pest) data is taken from every tenth tree in every ninth row.

Tree height is measured to the nearest foot using a pole graduated in one foot increments. With practice it was found that heights could be accurately estimated in trees less than 12 feet tall. This greatly speeded the work. Heights were recorded by deformity classes as follows:

Class 0 - No apparent deformity

" 1 - "Correctable" deformity. These are cases in which the tree apparently will grow into a sawlog quality stem in spite of the problem. (For example, trees with only a small crook within 12" of the ground that will remain in the stump).

" 2 - "Pulpwood" deformity. These are trees in which the deformity will throw the stem from a sawlog to a pulpwood class. (e.g. excess sweep or crook)

" 3 - Unmerchantable. Some trees have twisted crooked, multiple stems that will never find a home in any market except for possible fuelwood chips.

Because this market does not presently exist it was not considered further in the appraisals. Should an active market develop, reassessment of these data would be necessary.

" 4 - Missing trees - The cause of these absences may be anything from spittlebug to planting "misses" on failures. They were recorded to fill out a complete picture of the condition of the plantation.

Mean heights were calculated and compared with heights from normal growth data for that site index and age.

Time did not permit examination of many plantations in 1979. Those done showed height and growth reductions of up to 48 percent in plantations less than ten years old. In addition, 20 percent missing trees were recorded some of which apparently were due to spittlebug because of their relative location to other trees showing damage and ground cover of sweet fern or other spittlebug host plants.

Appraisals using this system are planned for all moderate and high risk plantations less than ten years old identified in the June 1979 risk rating survey as soon as time permits. Also plantations identified during compartment examination as having past insect damage from spittlebug (or other specific pests) will be appraised to offer up-dated data for modifying management decisions.

GYPSY MOTH (Lymantria dispar)

At Michigan State University's Department of Entomology researchers focused upon development of new methods to interpret the relationship of gypsy moth catch in attractant-baited survey traps to actual population numbers and distribution. Field tests were conducted in a 5x5 mile block of deciduous forest near Midland, with scattered fields and clearings comprising 15 percent of the total area. Traps were spaced ½ mile apart and

male moths were released from a single point and uniformly from a ½ x ½ mile block in the trap grid center. The rate of capture of released males was 1 percent from the center release and 4 percent from the uniform release. These values and their distribution over the grid traps indicate that only 4 percent of male gypsy moths disperse more than ½ mile and on average survey traps ½ mile apart catch 4 percent of the actural males present. If this research is continued in 1981, we hope to verify these values and to calibrate trap catch for other survey densities. This information should improve our understanding of the actual distribution of this pest in Michigan and elsewhere.

PILOT TESTS

SPRUCE BUDWORM DEMONSTRATION AREA

This three year project was begun this summer by Michigan State University's Department of Entomology. Two demonstration areas have been located in spruce-fir stands in the Upper Peninsula and additional areas are planned. In each area, a different type of partial harvest will be made prior to widespread tree mortality from the budworm. The configurations of the partial cuts will be strip cut, patch clearcut, and group selection. The budworm population level, impact on the residual stand, and forest regeneration will be monitored and compared for the different partial cuts.

HERBICIDAL SUPPRESSION OF SWEET-FERN

A pilot study was initiated in September to determine the feasibility and cost of reducing sweet-fern to acceptable levels on moderate and high risk red and jack pine planting sites and young plantations. This would serve to greatly reduce the risk of injury from the Saratoga spittlebug, and eliminate a strong competitor for soil moisture. Significant increases in site quality have been realized by suppressing sweet-fern and blue-berry.

We selected five locations in Region II (Osceola, Wexford, Crawford, and two in Cheboygan County) in young red or jack pine plantings with a high density sweet-fern ground cover. A back-pack mist blower was used to apply three concentrations of two herbicides in study plots at each location. Pre-spray data was collected in all spray plots and a control plot at each location. The plots were sprayed from September 17-21, or about one week before fall color. These plots will be re-evaluated in June, 1980, to determine the effectiveness of each dosage in controlling sweet-fern.

PINE ROOT COLLAR WEEVIL

This cooperative project involving the Michigan Department of Natural Resources, Michigan State University, and U.S. Forest Service was completed during 1979. The purpose of the project was to test early basal pruning and duff removed for control of pine root collar weevil.

Fourteen study plantations were initially established in 1977 but only ten were sampled in 1978 because the landowners treated or removed the test trees making the study invalid in four of the private plantings. In the late summer of the year following treatment, the treated Scotch pines showed 7 to 64 percent reduction in larval populations while the treated red pines showed 7 to 51 percent reduction. It appears that population levels can be reduced, but only to a certain degree with this technique. There are always some crevaces and hiding places around the root collar permitting some niches for adults to hide in and lay eggs. It appears that when populations are higher there is proportionally more reduction as has been shown in past studies on red pine. The number of larvae that survive are about the same no matter what the initial population. The important point, however, is that the threshold population which results in tree mortality is between 2.2 and 3.0 larvae depending upon tree size and degree of previous injury. The treatment tested generally reduces the population below this threshold, allowing the tree some recovery. In

three plantations however, the larval populations were higher than expected after treatment. Examinations showed that the pruning in one of the plantations was insufficiently high on the tree to be effective. Pruning removed less than 18 inches of the lower branches. The remaining branches sagged and shaded the tree bases, which apparently allowed the weevils to lay more eggs. The other two plantations contained much larger trees capable of sustaining more weevils at higher population densities.

Two of the Scotch pine plantations had exceptionally low population levels. This was attributed to chemical treatments applied to the foliage for control of other insects. Though the chemicals were applied for other Christmas tree pests, weevils crawling on the trees at night most likely contacted the insecticides. As populations of the weevil were also reduced by the pruning treatment, inadvertent integrated control had been implemented.

The average required time for early basal pruning and litter removal was two minutes per tree using long-handled saws. Because data were obtained on Scotch pine, time estimates would be about the same to slightly conservative for red pine since red pine has fewer, but slightly larger diameter branches. Based on a $4/hr. labor cost and full stand stocking, the cost per tree is estimated at slightly less than 15 cent per tree for either Scotch or red pine.

JACK PINE BUDWORM

Four Upper Peninsula jack pine stands were selected during 1977 as sites on which to test residual overstory removal as a method for reducing jack pine budworm hazard. The stands are about 80 acres in size and consist of adequately stocked regeneration overtopped with various densities of residual overstory trees.

During 1978, the overstory trees were removed from about 75 percent of each stand and left on the remaining 25 percent to serve as a control. Budworm populations were monitored during 1978 and 1979 but numbers are still at endemic levels in the study areas. Monitoring will be continued through the next outbreak.

PREVENTION AND CONTROL

OPERATIONS INVENTORY

It is a strong conviction of specialists involved in the pest management program that most of the recoverable losses we are attempting to recover are going to be regained through applications of silvicultural techniques to make stands less susceptible to attack and more resistant to loss should attack occur. These silvicultural operations (or direct controls for that matter) can only be applied when stands are identified on an individual basis and particular pest problems are diagnosed for subsequent treatment or potential problems are predetermined and suitable prevention measures taken. Therefore it is critical that pest considerations become a functional part of the operations inventory and management planning process. In this system stands are examined on an individual basis and necessary treatments prescribed. Approximately 10 percent of the forest is examined each year on this basis and the prescribed treatments accomplished as soon as possible. This makes operations of great magnitude possible by a series of approximately equal smaller annual efforts. In addition the age structure of any type on the forest is spread over a ten year period once the forest has reached a regulated condition. The operations inventory is therefore the important basic data gathering tool in forest management. All subsequent operations are based upon data gathered here as modified by updates as operations are accomplished and stand condition changes.

While all pest operations cannot be tied to a year of entry on a ten year cycle (e.g. emergency suppression of red-headed pine sawfly), the silvicultural manipulations designed to reduce risk and/or loss, risk rating, damage appraisal of previously injured stands, and other prevention measures must be accomplished on this basis to allow forest management operations to proceed in an orderly fashion.

Pest data therefore should be collected by stand examiners just as other forest management data. Review of the current operations inventory manual prompted the following suggested changes in coding which will begin with the 1982 compartment examinations.

Field	Columns	Ground Cover
33	44	(0) Sweetfern

The remainder of the categories under ground cover are the same. The major changes are in insects, disease, and other problems.

Field	Columns	Insects, Disease, and Other Problems
35	48	When a pest problem exists (if codes 1-8 used) specify the pest on the remarks card. Indicate the worst condition on 10 acres or more of stand.
		(0) Healthy - no problems.
		(1) Deformed trees - describe deformity and note degree (acres and/or percent of trees deformed).

(2) Pockets of stunted, dead or missing trees-note degree and describe (e.g., 30 percent stunted, four acres missing, 20 percent of 10 acres dead).

(3) Dead or flagged branches, needles, or tips-note specific symptoms and degree (e.g., 20 percent of tips flagged, dead branches on 75 percent of trees).

(4) Defoliation - note species and degree (e.g., 75 percent of sugar maple 50 percent defoliated, or one half new growth on all jack pine).

(5) Stem Cankers - note species, height frequency and degree (e.g., one or two at 3-5' height on aspen on west 10 acres of stand).

(6) Conks - describe and note degree and species (three gray conks/tree on 20 trees/acre in W½ of stand).

(7) Weather Related - describe and note degree species (e.g., ice broken tops in ½ of trees on 15 acres in NW corner).

(8) Other Animal Pests - describe and note degree and species (e.g., porcupine killed tops in some red pine along north edge 10 acres).

(9) Unknown - describe and indicate if further investigation is necessary (e.g., dead needles on terminals of most pine 3-5' tall, check).

It was felt that stand examiners could recognize these symptoms readily in the field thus making their job easier than under the old system which required them to identify the cause of the problem to some extent and determine the degree of infestation. As with other operations inventory information the current method collects data describing stand conditions that once evaluated by pest specialists enables resource professionals to make management decisions. Training will be offered to stand examiners on recognition of the damage symptoms and use of the system in early 1980 so that the system can be applied to examination of 1982 compartments.

Pest Specialists have reviewed stands coded as having insect and disease problems under the 1980 and 1981 operations inventory. Recommendations regarding these problems were given to forest managers at or, when possible, prior to compartment reviews. Damage losses from past pest problems was appraised (as time permitted). Time was spent with forest managers discussing implications of problems detected including management strategies and economic analysis of these strategies.

Plantations and planting sites were risk-rated for Saratoga spittlebug, red-headed pine sawfly and jack pine budworm. Growth relative to "normal"

and incidence of deformity especially as related to spittlebug and white pine weevil were noted in plantations. Conditions found were evaluated and discussed with forest managers.

INFORMATION AND EDUCATION

THE TEAM APPROACH TO TECHNOLOGY TRANSFER

The Michigan Cooperative Forest Pest Management Team addressed the topic "The Team Approach to Technology Transfer" at the 1979 Central International Forest Insect and Disease Conference in Merrimac, Wisconsin. The subject of the talk was the Saratoga spittlebug workshop presented by the Forest Pest Management team in June, 1979. The spittlebug workshop represented both an advance in technology development and in the transfer of technology to public and private forest land managers.

UPPER PENINSULA INFORMATION MEETING

A spruce budworm information meeting was held in Escanaba, Michigan on December 13th, 1979. Approximately 75 persons representing small private landowners, corporations and public forest management agencies attended an all day session aimed at information exchange on the budworm problem. Technical recommendations on silvicultural options were provided by Bob Frank and John Benzie, USDA-FS. A review of the budworm and its current status was given by Nancy Breisch, Michigan Technological University; Bob Heyd, Michigan Department of Natural Resources; and Bob Ford, USDA-FS. Current and potential utilization options for damaged fir was presented by Steve Sinclair, University of Minnesota. Dan Schmitt, CANUSA-East highlighted CANUSA research in progress. An overview of demonstration projects was given by Bob Ford, USDA-FS; Karen Olson, Greentree Consultants; and Marcia McKeague, Michigan State University. John Witter, University of Michigan and Gary Simmons, Michigan State University, detailed research studies being conducted in the Upper Peninsula.

Attendees indicated a need for additional information on options available today to help address the problem. Private landowners voiced particular concern that large-scale spraying programs had not been contemplated for the Upper Peninsula.

The information meeting was hosted by Nancy Breisch and Bob Heyd and was coordinated by John Witter and Gary Simmons. Many agencies co-sponsored the meeting including: Michigan Technological University, University of Michigan, Michigan State University, Michigan DNR, USDA-FS, CANUSA, the Cooperative Extension Service and the Michigan Cooperative Forest Pest Management Program. An information booklet summarizing the formal program was distributed to all attendees. Additional copies may be obtained by contacting John Witter or Gary Simmons.

SARATOGA SPITTLEBUG MANAGEMENT WORKSHOP

The Forest Management Division of the Michigan Department of Natural Resources in cooperation with the U.S. Forest Service (N.C.F.E.S.) and Michigan State University presented a workshop on the Saratoga spittlebug on June 18, 1979, at the Osceola Hotel in Reed City, Michigan. This workshop was attended by approximately 15 forest managers, both public and private.

The objective of the workshop was to inform foresters of the current technology available in managing plantation red pine to reduce losses from the Saratoga spittlebug. Forest Pest Management Specialists Dan Mosher, Ron Murray, Jeff Olson, and Bob Heyd of the Michigan Department of Natural Resources;

Louis Wilson of the N.C.F.E.S., U.S. Forest Service; and Gary Simmons and Marcia McKeague from Michigan State University presented the program. Topics included: history of the problem, impact, detection, risk-rating planted and unplanted sites, predicting growth loss, tree deformity and tree mortality, stand dynamics and preventive management and suggestions for future action. Interaction with workshop participants was stressed. The afternoon was devoted to field examination and demonstration of the principles discussed.